KEITHLEY

Model 485 Addendum

The following information is supplied as a supplement to this manual in order to provide the user with the latest improvements. It is recommended that verification information be added to Section 3 of the Model 485 Instruction Manual and calibration information be added to Section 5.

This addendum contains complete procedures for verifying and calibrating the Model 485 using the Keithley Model 263 Calibrator/Source. Complete separate procedures are provided for performing digital calibration from either the front panel or over the IEEE-488 bus. Digital calibration over the bus is automated using a BASIC program run by the HP 85 computer.

PERFORMANCE VERIFICATION USING MODEL 263 CALIBRATOR/SOURCE

Use of the Model 263 to verify accuracy specifications of the Model 485 simplifies the procedure by eliminating the need for user designed current sources. The equipment listed in Table 3-1 of the manual is not needed.

Ideally, performance verification should be performed when the instrument is first received to ensure that no damage or change in calibration has occured during shipment. It may also be performed when instrument accuracy is suspect or following calibration. If performance on any of the ranges is outside the specified limits, calibrate the instrument.

NOTE

If the instrument does not meet specifications and is still under warranty (less than 12 months since date of shipment), contact your Keithley representative or the factory to determine the action to be taken.

Environmental Conditions

All measurements should be made at an ambient temperature between 18° and 28°C (65° to 82°F) with a relative humidity less than 70%.

Initial Conditions

Before performing the verification procedure, make sure the Models 485 and 263 meet the following conditions:

1. If the instruments have been subject to temperatures below 18°C (65°F) or above 28°C (82°F), allow sufficient time for the instruments to reach temperatures within the range. Generally, it takes one hour to stabilize an instrument that is 10°C (18°F) outside of the specified range.
2. Turn on the Models 485 and 263, and allow them to warm up for one hour. The Model 485 may be operated from either line power or battery pack power, as long as the battery pack has been fully charged.

Verification Procedure

Proceed as follows to verify the accuracy of the Model 485:

1. On the Model 485, press ZERO CHECK and select the 2nA range.
2. With an open input, adjust the ZERO pot for .0000 ±1 count on the display.
3. Connect the Model 263 to the Model 485 as shown in Figure 1. Make sure the calibrator is in standby.
4. Release ZERO CHECK on the Model 485.
5. Using the AMPS (active) current source, program the Model 263 to output 1.90000nA and verify that the reading is within the limits in Table 1.
6. Using Table 1 as a guide, check the rest of the current ranges by applying the appropriate current and verifying that the reading is within the allowable limits.

Table 1. Range Accuracy

485 Range	263 Output (AMPS)	Allowable Reading* (18°C -28°C)
2 nA	1.90000 nA	1.8933 to 1.9067
20 nA	19.0000 nA	18.936 to 19.064
200 nA	190.000 nA	189.69 to 190.31
2 μA	1.90000 μA	1.8976 to 1.9024
20 μA	19.0000 μA	18.986 to 19.014
200 μA	190.000 μA	189.86 to 190.14
2mA	1.90000mA	1.8986 to 1.9014

*Includes Model 263 error.

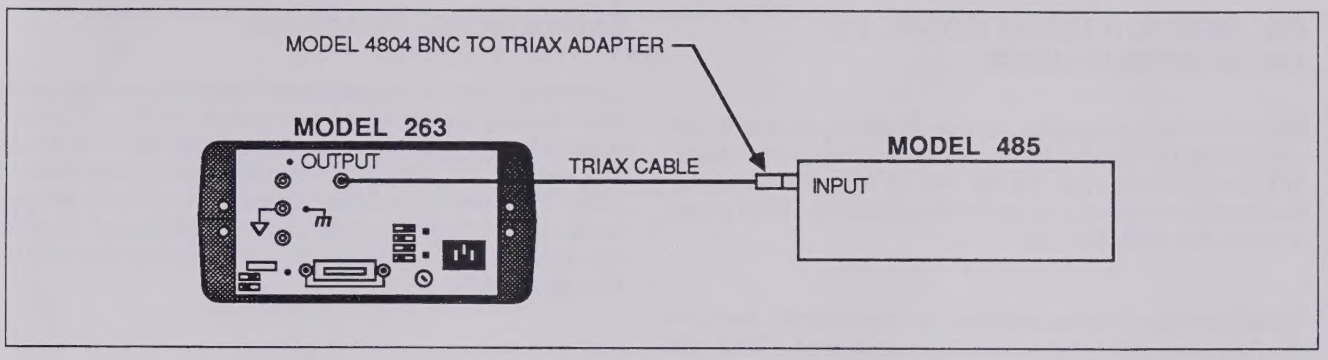

Figure 1. Model 485 Verification Connections

CALIBRATION USING MODEL 263 CALIBRATOR/SOURCE

The following paragraphs provide detailed procedures for calibrating the Model 485 Picoammeter using the Model 263 Calibrator/Source. All but one of the calibration adjustments are digital and can be done from the front panel or over the IEEE-488 bus.

To calibrate the instrument from the front panel, perform the following procedures, omitting paragraph "IEEE-488 Bus Calibration". To calibrate the Model 485 over the IEEE-488 bus, perform the following procedures, omitting paragraph "Front Panel Calibration".

Calibration Storage Enable

The Model 485 must be in calibration storage enable to store calibration constants in NVRAM. If the instrument is not placed in this mode, subsequent calibration will be lost when the instrument is turned off. Perform the following steps to enable calibration storage.

1. If the Model 485 is presently on, turn it off.
2. While holding in the STO/CLR button, turn the instrument back on.
3. When the "CAL" message is displayed, release the STO/CLR button. The instrument will return to the normal display mode and the storing of calibration constants is now enabled.

Required Equipment

The following items (one of each) are necessary to calibrate the Model 485:

1. Keithley Model 263 Calibrator/Source.
2. Triax to Triax Cable (supplied with 263)
3. Keithley Model 4804 Male BNC to Female Triax Adapter.

NOTE: The following additional items will be neccesary if calibration is to be performed over the IEEE-488 bus.

4. Keithley Model 4853 IEEE-488 Interface installed in the Model 485.
5. HP 85 Computer equipped with HP 82937 GPIB Interface and I/O ROM.
6. Keithley Model 7008 IEEE cable.

Environmental Conditions

Calibration should be performed under laboratory conditions having an ambient temperature of 23 ±1°C and a relative humidity of less than 70%. With both the Model 485 and 263 on, allow them to warm up for one hour. If either instrument has been subjected to extreme temperature or humidity, allow at least one additional hour for the instrument to stabilize before beginning the calibration procedure.

NOTE

Calibration can be stopped at any time and only those ranges out of specification need be calibrated.

Front Panel Calibration

Perform the following steps to calibrate the Model 485 from the front panel:

1. On the Model 485, depress ZERO CHECK and select the 2nA range.
2. With an open input, adjust the ZERO pot for .0000 ±1 count on the display.

NOTE

If Q104, U105, R113, R114 or R115 have been replaced, the picoammeter may not zero. See paragraph 5.7 in the Model 485 Instruction Manual for the procedure to balance the input amplifier.

3. Connect the output of the Model 263 Calibrator/Source to the input of the Model 485 as shown in Figure 2. Make sure the calibrator is in standby.
4. On the Model 485, press the REL and LOG pushbuttons simultaneously and hold in until the message "CAL" is displayed. Release the buttons. The unit is now in the calibration mode as indicated by the "CAL" annunciator.
5. Release ZERO CHECK on the Model 485.
6. Program the Model 263 to output .00000 nA. Use the AMPS (active) current source.
7. The Model 485 may be displaying a small offset (≈1 count). To cancel this offset, press REL on the Model 485 to zero the display.
8. Program the Model 263 to output 1.90000 nA.
9. Adjust the display of the Model 485 to read 1.9000nA using the STO/CLR and RCL buttons. The STO/CLR button increments the displayed reading and the RCL button decrements the displayed reading.

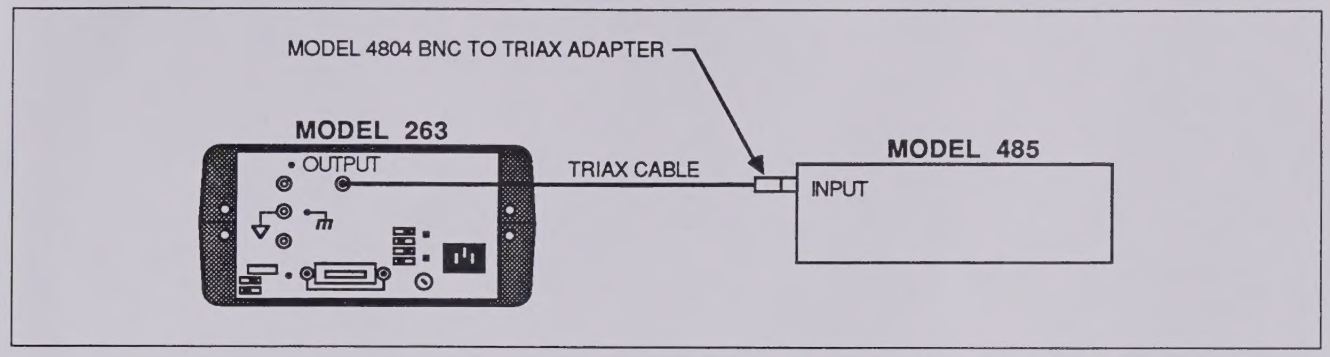

Figure 2. Model 485 Calibration Connections

10. Using Table 2 as a guide, repeat the basic procedure outlined in steps 5 through 9 to calibrate the rest of the current ranges of the Model 485.
11. To store calibration constants and exit the calibration mode, simultaneously press the REL and LOG buttons until the message "Stor" is displayed. If instead the message "out" is displayed, then calibration storage was not enabled and calibration constants will be lost when the Model 485 is turned off.

Table 2. Model 485 Range Calibration

485 Range	263 Output Current	485 Reading
2 nA	1.90000 nA	1.9000nA
20 nA	19.0000 nA	19.000 nA
200 nA	190.000 nA	190.00 nA
2 μA	1.90000 μA	1.9000 μA
20 μA	19.0000 μA	19.000 μA
200 μA	190.000 μA	190.00 μA
2mA	1.9000 mA	1.9000mA

IEEE-488 Bus Calibration

Perform the following steps to calibrate the Model 485 over the IEEE-488 bus using the Model 263 Calibrator/Source.

1. Connect the Models 263 and 485 to the GPIB interface of the HP 85 computer. The Model 485 must have a Model 4853 IEEE-488 Interface installed.
2. Make sure the IEEE-488 address of the Model 263 is set to 8 and the address of the Model 4853 is set to 22.
3. Enter the calibration program into the HP 85 computer.
4. To calibrate the instrument, simply press the RUN key on the computer. The program will prompt for the only manual adjustment and then automatically calibrate all the current ranges of the Model 485.
5. The program will prompt for storage of the calibration constants (line 330). This provides the user the opportunity to stop at this point to avoid permanent calibration. The calibration constants will be lost when the Model 485 is turned off.
6. Storage of calibration constants is performed on line 350 of the program and is indicated by the "Stor" message on the Model 485. If instead the message "out" is displayed, calibration storage was not enabled and calibration constants will be lost when the Model 485 is turned off.
7. After calibration is completed, it is recommended that you source a current from the Model 263 to each range at ± half scale to verify accuracy.

```
10 CLEAR 722 @ CLEAR
20 WAIT 1000
30 OUTPUT 722 ;"C1R1X" ! 485; set to 2nA range and enable ZERO CHECK.
40 BEEP @ DISP "ADJUST 'ZERO' POT ON 485 FOR    .0000 +/-1 COUNT."
50 DISP
60 DISP "IF DISPLAY WILL NOT ZERO, PRO-  CEED TO PARAGRAPH 5.7 IN THE 485MANUAL.
70 DISP
80 DISP "PRESS 'CONT' KEY ON THE HP 85 TOCONTINUE."
90 PAUSE
100 CLEAR @ BEEP
110 DISP "CONNECT 263 OUTPUT TO 485 INPUT (SEE FIGURE 2)."
120 DISP
130 DISP "PRESS 'CONT' TO CONTINUE."
140 PAUSE
150 DATA 1,.0000000019,2,.000000019,3,.00000019,4,.0000019,5,.000019,6,.00019,7,
160 CLEAR
170 CLEAR 708
180 OUTPUT 708 ;"F1R4V1.9E-9X" ! 263; program for 1.9nA.
190 OUTPUT 722 ;"C0X" ! 485; disable ZERO CHECK.
200 FOR I=4 TO 10
210 READ J
220 OUTPUT 722 ;"R";J;"X" ! 485; select range.
230 OUTPUT 708 ;"R";I;"X" ! 263; select range.
240 OUTPUT 708 ;"Z1O1X" ! 263; output zero amps.
250 WAIT 3000
260 OUTPUT 722 ;"Z1X" ! 485; enable REL to cancel offset.
270 READ J@ WAIT 2000
280 OUTPUT 708 ;"Z0X" ! 263; source programmed output.
290 WAIT 2000
300 OUTPUT 722 ;"V";J;"X" ! 485; send calibration value.
310 OUTPUT 722 ;"Z0X" ! 485; disable REL.
320 NEXT I
330 BEEP @ DISP "TO STORE CAL CONSTANTS, PRESS   'CONT'."
340 PAUSE
350 OUTPUT 722 ;"L0X" ! 485; store cal constants.
360 CLEAR @ BEEP
370 DISP "CALIBRATION COMPLETE"
380 END
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485 CALIBRATION PROGRAM